

An Evolutionary Framework for Analyzing the Distance Preserving Property of Weighted Graphs

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A subgraph H of a given graph G is *isometric* if, the distances between every pair of vertices in H are the same as the distances of those vertices in G . We say a graph G is *distance preserving* if there exists an isometric subgraph of every possible order up to the order of G . Here, we propose a biologically-inspired search algorithm to address the problem of finding isometric subgraphs that consequently determines if a given graph is distance preserving. In this algorithm, using a well defined fitness function, selection operator selects almost isometric subgraphs to generate the offsprings for the next generation. There is a tradeoff between the population size and searching speed. On the one hand, the larger the population size is, the slower the search algorithm would be. On the other hand, by increasing the population size, we increase the likelihood of finding an existing isometric subgraph. Experimental results depict the performance of the proposed algorithm in finding isometric subgraphs even for challenging problems and interestingly by these results one can see that “almost” all graphs are distance preserving. In closing, we show the smallest distance preserving graph whose product factors are not distance preserving. This graph has 80 vertices, and can be used as benchmark for algorithms in this concept.

Keywords: Distance preserving, evolutionary algorithm, fitness function, isometric subgraphs, mutation, selection.